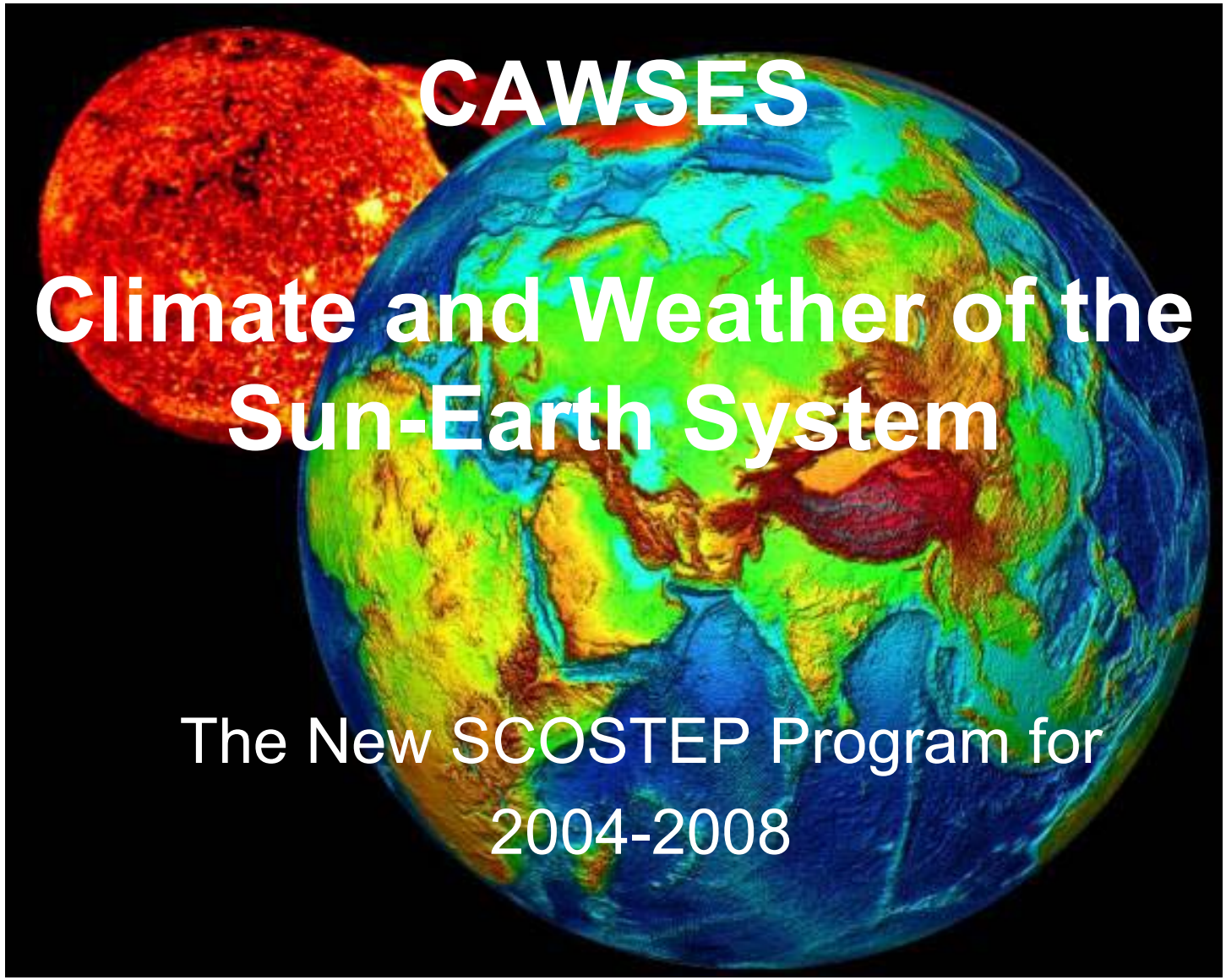


Composite picture created at NOAA-NGDC by Dr. Peter Sloss from SKYLAB solar X-ray telescope picture by Naval Research Laboratory and bathymetry and topography databases archived at NGDC.

SCOSTEP

SCOSTEP's mission: to implement research programs in solar-terrestrial physics that benefit from international participation and that involve at least two ICSU bodies.

SCOSTEP Bureau

- President: M. A. Geller
- Vice-president: R. A. Vincent
- Scientific Secretary: J. H. Allen
- S. K. Avery (URSI)
- W. Baumjohann (IAGA)
- R. Fujii (COSPAR)
- B. Schmieder (IAU)
- F. W. Sluijter (IUPAP)
- T. Tsuda (IAMAS)

Recent SCOSTEP Programs Pertaining to Individual Disciplines: 1998-2002

- ISCS: Solar physics
- PSMOS: Middle atmosphere physics
- EPIC: Equatorial regions
- S-RAMP: Further the objectives of STEP. An event-oriented multi-regional study, Space Weather Month (September 1999), was conducted by S-RAMP and used the array of ISTP satellites still operational.

Single SCOSTEP Programs

- SCOSTEP has sometimes sponsored single programs, receiving virtually all of SCOSTEP's energy:
  - STEP in 1990-97
  - MAP in 1982-85
  - IMS in 1976-79

- SCOSTEP is now preparing a single, comprehensive program called "CAWSES" (Climate and Weather of the Sun-Earth System), to be implemented in 2004-2008.

CAWSES Scientific Steering Group

- Chair: Sunanda Basu, USA
- Jean-Louis Bougeret, CNRS, France
- Joanna Haigh, Imperial College, UK
- Yohsuke Kamide, STEL, Japan
- Arthur Richmond, NCAR, USA
- C.-H. Liu, NCU, Taiwan
- Lev Zelenyi, IKI, Russia
- Secretary – Joe Allen

Spatial Domain Concepts of the Solar-Terrestrial System

- Sun
- Heliosphere
- Magnetosphere
- Thermosphere/Ionosphere
- Middle Atmosphere
- Lower Atmosphere and Climate

Temporal Variations Within the Coupled Solar-Terrestrial System

Examples of time-sorted phenomena with linkage between traditional STP science:

Minutes-Hours	Days-Weeks	Months-Years	Decades-Centuries
Solar Flares CMEs Geomagnetic Storms Substorms Ionospheric Currents and Structure Gravity Waves Turbulence Reconnection Radiation Belt Enhancement	Solar Rotation Emerging Flux Features Trapped Particles Magnetic Clouds Geomagnetic Storms Radiation Belt Dynamics	Solar Cycle Solar Dynamo Solar Wind Variance Cosmic Rays Middle Atmosphere Composition, Dynamics, Temperature SAO & QBO	Solar Irradiance Changes Earth Surface Temperature Ozone Changes Galactic Cosmic Rays Maunder Minimum Climate Change

Unresolved Questions for the CAWSES Program

- Can we link the processes that produce geomagnetic storm effects?
- Can we identify long-term variations of solar luminosity and resultant impacts on global change?
- To what extent is the geospace system modulated by solar activity on different time scales, and how does this modulation interact with forcing from the lower atmosphere?
- Can we reconcile various apparent responses of the middle and lower atmosphere to solar activity, in relation to anthropogenic influences, and can we estimate future changes?

Timeliness of the CAWSES Program

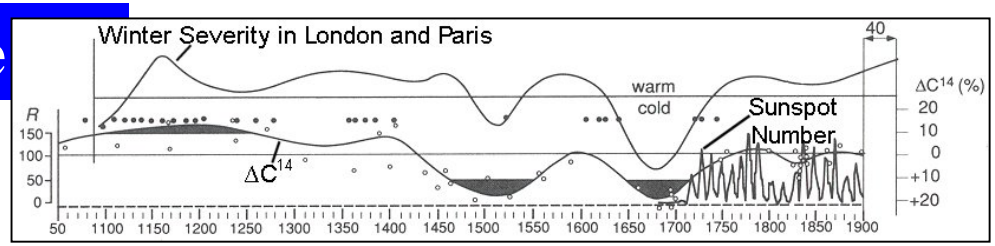
- The public increasingly recognizes the importance of climate variability and space weather.
- New observational systems and modeling/analysis tools enable studies of complex coupled systems.
- CAWSES can help mobilize and coordinate national programs in solar-terrestrial physics, and support other international programs like ILWS.
- Internet technology facilitates international collaborations that can include scientists in nations without space programs.
- CAWSES can help articulate new directions for future solar-terrestrial research involving observations, modeling and applications.
- New technology can offer unprecedented educational opportunities for students at all levels.

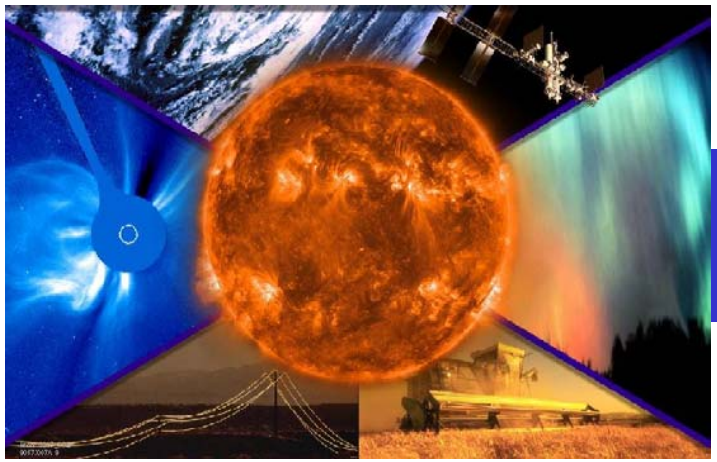
Strategy

- Collect data records to document with increasing fidelity various aspects of the Sun-Earth system.
- Use physically based models for assimilating observed data and deriving enhanced outputs for segments of the solar-terrestrial system.
- Mobilize SCOSTEP researchers to work together to understand variability throughout the entire solar-terrestrial system.

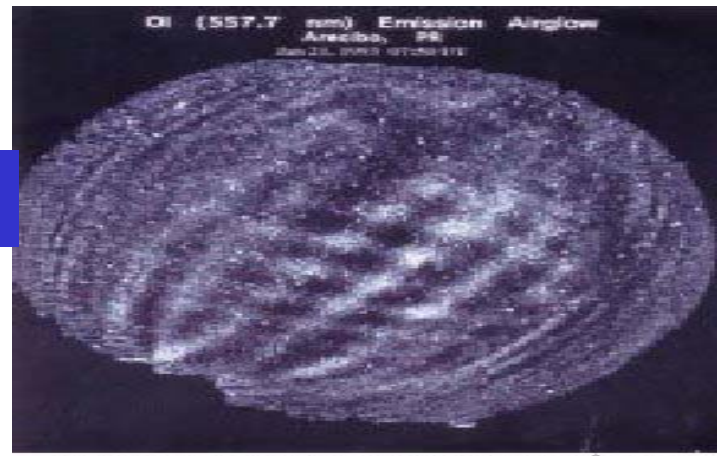
Four Themes under CAWSES

Solar Influence on Climate



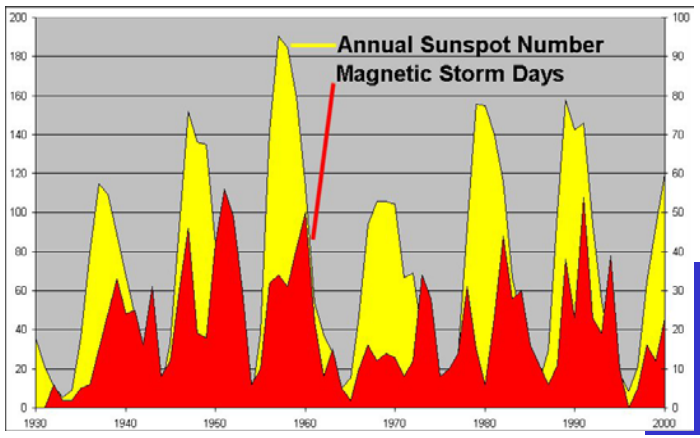


Space Weather: Science and Applications

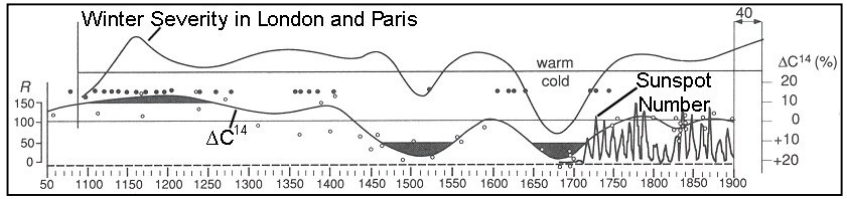


Wave structures in atomic oxygen 5577 Å image.

Atmospheric Coupling Processes

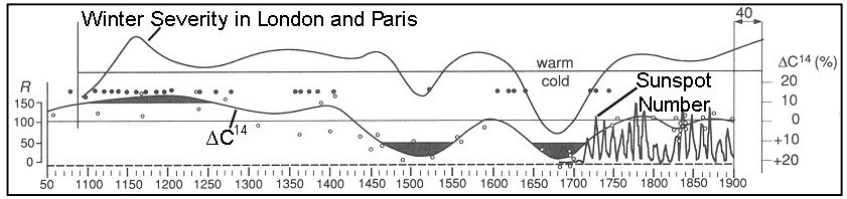


Climatology of the Sun-Earth System



1. Solar Influence on Climate

- Effects of solar variability on middle and lower atmosphere
- Variability of spectral irradiance, energetic particles & cosmic rays
- Study of paleoclimates
- Study of extreme environments in the Sun-Earth system

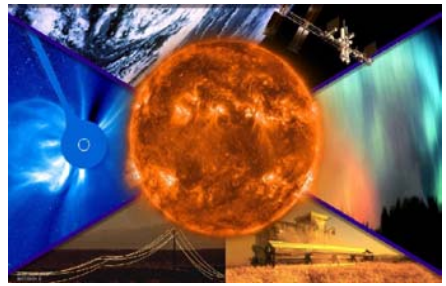


1. Solar Influence on Climate

Chair- M. Lockwood, Rutherford-Appleton Lab, UK

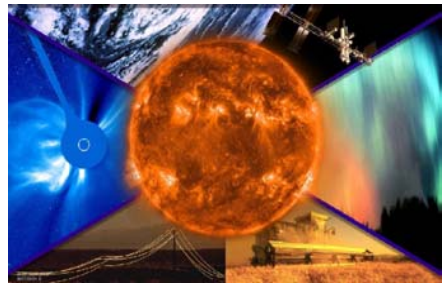
Proposed working groups

- Interpretation of past climate change during the Holocene
- Modeling of century-scale climate change
- Detection and interpretation of solar cycle signal in recent climate data
- Development and testing of mechanisms for the amplification of solar influence



2. Space Weather: Science and Applications

- Impacts on space technology and operations
- Effects on humans in space
- Telecommunications interruptions
- Vulnerability of Earth-surface systems
- Navigation upsets
- Effects on high-altitude aircraft passengers and crew
- Model development through quantitative understanding of multi-scale coupling in the Sun-Earth system



2. Space Weather: Science and Applications

Co-Chair- Janet Kozyra, U. of Michigan, USA

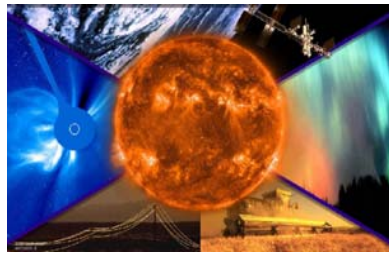
Co-Chair - K. Shibata, Kyoto University, Japan

Proposed campaign framework that views the "whole earth as an instrument" for making key space weather observations. CAWSES could:

- Recruit and coordinate needed observing sites
- Identify and collaborate with major programs worldwide (Spaceship Earth, Intermagnet, GEDAS, SCINDA, etc.)
- Set up website and needed technology in collaboration with other programs like ILWS, NSWP, etc.
- Organize world-wide analysis campaigns on particular themes or for selected events

2. Space Weather: Science and Applications

Potential Worldwide Campaigns



- Predictive Models of the Space Environment
  - Post event analysis to test predictive models
  - Analysis of physical processes that occurred & reasons predictions succeeded or failed
  - Test research models against operational predictions
- Document Actual Effects on Life & Society for Events
  - Power grid loading
  - Satellite anomalies
  - Communications problems
- Sun-to-Earth Analysis Campaigns for Selected Events
  - Coordinate CAWSES worldwide maps with other satellite and ground-based data to create global view of events
  - Coordinate efforts of worldwide research community to analyze and interpret comprehensive data sets
  - Apply new knowledge of complex system to understanding & predicting space weather effects on society

Wave structures in atomic oxygen 5577 Å image.

3. Atmospheric Coupling Processes

- Coupling of spatial domains through dynamic, radiative and/or electrodynamic processes
- Coupling through transport of atmospheric constituents
- Observations, theory and modeling to be utilized for understanding coupling processes
- Coupling processes important for understanding of Space Weather, Space Climatology and Solar Influence on Climate

Wave structures in atomic oxygen 5577 Å image.

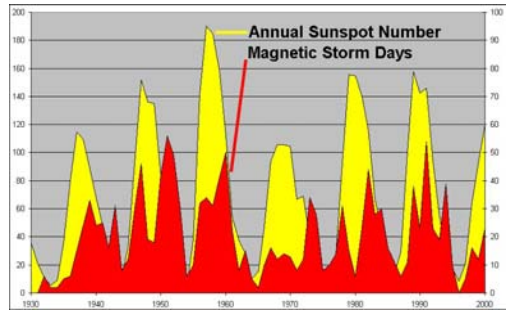
3. Atmospheric Coupling Processes

Chair- F.-J. Luebken, IAP, Kuehlungsborn, Germany

Proposed working groups:

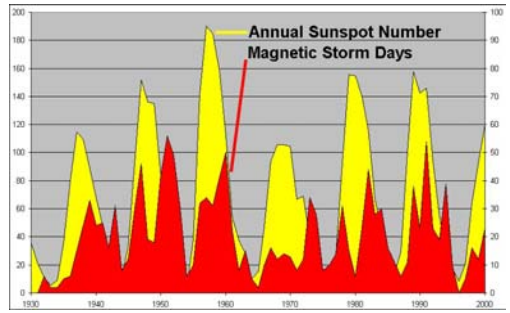
- Atmospheric coupling by gravity waves, tides, and planetary waves: sources, sinks, and transfer
- Coupling by electrodynamics and ionospheric/magnetospheric processes
- Variability of energy and momentum budgets of the middle atmosphere
- Particles and minor constituents in the upper atmosphere: solar-terrestrial influences and their role in climate

4. Space Climatology



- Study regular variations, long-term trends and statistical properties of irregular variations with help of models
  - Temporal scales from mins/hours to centuries/millennia
- Quantify probabilities of extreme events
- Understand processes that influence the climate
- Critically assess long-term trends, joining SPARC for assessment of middle & upper atmosphere trends

4. Space Climatology



Co-Chair - J. Sojka, Utah State University, USA
Co-Chair - C. Frohlich, World Radiation Center, Switzerland

Facilitate access to and analysis of long-term data sets

- Total solar irradiance variability
- Upper atmosphere trends
- Radiation belt climatology
- Long-term cosmic ray variability
- Long-term trends in geomagnetic activity
- Historical aurora data

CAWSES Capacity Building & Education

- CAWSES will hold meetings and provide specialized training courses for scientists from developing nations and help with computational and data resources
- Establish partnerships between developing & industrialized nations
- Develop material to educate the public about solar-terrestrial science, its impact on technology & the global environment

Perspectives on CAWSES

- CAWSES is an ambitious program that builds on and leverages the broad SCOSTEP programs STEP and S-RAMP and more specialized Post-STEP programs.
- CAWSES is particularly timely.
- Successful implementation of CAWSES will provide an integrated scientific framework for solar-terrestrial research in the future, and provide an informed basis for guiding later programs under different solar conditions and changing anthropogenic influences and as made necessary by new human institutions and technological advances.